FOREST PEST MANAGEMENT
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BIOLOGICAL EVALUATION OF SAPLING MORTALITY IN THE NORTH SHIRTTAIL CREEK PLANTATION, FORESTHILL RANGER DISTRICT, TAHOE NATIONAL FOREST

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PSW FOREST AND RANGE EXPERIMENT STATION
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ABSTRACT

Branch flagging and tree mortality of sugar pine and tree mortality of Douglas-fir were found to be caused by white pine blister rust and Armillaria root disease, respectively, in a 10+ year-old plantation near N. Shirttail Creek on the Foresthill District. An estimated 90% of the sugar pine have lethal cankers and will die within the next 5 years. Douglas-fir mortality has reached its peak and should decline as the trees become larger and more resistant to Armillaria. Depending upon the District's objectives, the plantation could be left untouched, interplanted, or destroyed and replanted. Ponderosa pine would be more resistant to Armillaria than Douglas-fir if either interplanting or replanting is the chosen option. Losses due to blister rust in sugar pine plantations which are infected only in the occasional wave year, can be prevented through a program of annual plantation examinations and the early pruning-out of rust infections.

INTRODUCTION

On February 25, 1982, Dick Smith, FPM pathologist, and Bob Rogers, District silviculturist, examined the N. Shirttail Creek plantation in response to the District's request for a biological evaluation.

The N. Shirttail Creek plantation is a 30-acre mixed planting of Douglas-fir, ponderosa and sugar pines. It was planted about 1970 and the trees are 6 to 12 feet tall. The plantation is on a south-facing slope and up out of the stream bottom and away from its immediate influence, which indicates conditions favorable for reducing the probability

of rust development. Some branch flagging of the sugar pine due to white pine blister rust was noted 2 to 3 years ago. This past fall (1981) the District observed more abundant branch flagging and some tree mortality of the sugar pine caused by the blister rust. Some Douglas-fir mortality of unknown cause(s) was also noted. The stocking level was approaching the lower limits and the District, needing a prognosis of future mortality on which to base management decisions for this stand, requested an FPM evaluation.

OBSERVATIONS

A lower-slope and a mid-slope transect were run through the plantation. Live sugar pine saplings were examined for the presence and kind (class) of white pine blister rust cankers. These cankers were graded into one of four damage classes as defined in Evaluation No. 79-3 by Byler and Parmeter (a copy is enclosed). Briefly these were:

Class 1 - non-lethal cankers
Class 2 - lethal, prunable cankers in the lower crown
Class 3 - lethal, prunable cankers in the upper crown
Class 4 - lethal non-prunable cankers

Lethal non-prunable cankers (class four) were found on 87% of the live sugar pine. Another 4% were infected with lethal prunable cankers (Class 2) and 9% of the living sugar pine were uninfected. All rust cankers examined originated in 1976, indicating that most all cankers resulted from a one year's infection wave. The Douglas-fir mortality was being caused by Armillaria root disease. This Douglas-fir mortality was clumped, probably around old buried stumps and roots of oaks cut during site preparation. The ponderosa pine did not appear to be as badly affected by the Armillaria as was the Douglas-fir.

BIOLOGY OF THE PESTS

White Pine Blister Rust. This rust disease, caused by the fungus Cronartium ribicola, attacks sugar and western white pines and several species of Ribes. The fungus is an obligate parasite which must alternate between Ribes and white pines. Spores produced on the pine branch and stem cankers in the spring infect the leaves of Ribes. Spores produced on Ribes leaves in the fall infect the needles of white pines. The fungus grows from the pine needle into the branch, where it forms a canker. This process can take from 2 to 3 years. The branch cankers enlarge and grow toward the main stem. Those within 24 inches of the stem have a good chance of reaching the stem and causing a stem or bole canker. Branch cankers cause branch flagging and in themselves are not very damaging to the tree. The real damage is done when the rust invades the main stem and causes a bole canker. Here the rust eventually girdles and kills the tree.

Rust infections in the Sierras occur most often in cool moist sites such as stream bottoms or around meadows. Temperature and moisture conditions are critical and must coincide with spore dispersal if infection is to occur. There are relatively few sites where these conditions occur frequently and infection takes place year after year. In most rusted sites, infection occurs only periodically when favorable conditions occur at the right time. These favorable periods of high infection are called wave years. 1976 was such a wave year. As one moves from the sites most favorable for rust to sites less favorable, the frequency of wave years decreases.

Armillaria Root Disease. This disease is caused by the widespread soil and root inhabiting fungus, Armillaria mellea. This fungus attacks a wide range of hosts, including most conifers. The seedling and sapling stages of conifers are the most susceptible: older age classes are fairly resistant unless injured or of poor vigor. This pest is a frequent inhabitant of the roots of oaks, which when healthy, are quite resistant and able to confine the fungus to small areas of their root system. But when these oaks are cut and killed, this resistance disappears and the fungus rapidly invades the whole root system and stump. With this large food base Armillaria becomes very aggressive and moves into surrounding trees by means of root contact or rhizomorphs. Rhizomorphs are root-like stuctures of Armillaria which grow through the soil and by which this fungus may spread to new hosts. Eventually the food base is used up and the pest becomes less aggressive, but this may take many years.

Armillaria becomes a problem in young plantations where oaks are cut and killed during site preparation. Conifer sapling mortality is caused when the roots of the sapling contact the Armillaria-infested root system and the fungus grows into the sapling roots. Usually this mortality does not extend out beyond the influence (root zone) of the infested oak stump.

MANAGEMENT OPTIONS

Management options for this kind of situation fall into 2 main classes: those management options aimed at working with the current situation and those aimed at preventing or reducing the likelihood of a similar undesirable situation developing in the future. The following alternatives pertain specifically to the current situation in the N. Shirttail Creek Plantation.

1. Do Nothing. Blister rust will kill approximately 90 percent of the remaining live sugar pine in the plantation. Douglas-fir mortality due to Armillaria is probably at its peak and will decline as the resistance of Douglas-fir increases with age and as the Armillaria food base is depleted. The ponderosa pine in the plantation, not affected by the rust and more resistant to Armillaria, will continue to remain vigorous and healthy.

2. Cut out infected sugar pine and interplant. The infected sugar pine could be cut out and the plantation interplanted with ponderosa pine, Douglas-fir, or a mixture of these two species. It may be preferable to interplant with ponderosa because of its greater resistance to Armillaria. Most of the remaining uninfected sugar pine (9% of the current live sugar pine) if left should reach merchantable size. Pine engraver beetles could build up in the cut green sugar pine slash and move out into the leave trees if consideration is not given to proper slash disposal or time of cutting.

3. Destroy the Plantation and Replant. If planted to ponderosa pine and/or Douglas-fir, some mortality due to Armillaria should be expected; but it should be less than the current stand has experienced, due to the decline in the Armillaria food base. If the District decides to deeprip the soil as one of its methods of reducing soil erosion, the amount of Armillaria food base would be further reduced as it is torn up and brought to the surface during the ripping process.

PREVENTION

Sugar pine is one of the major commercial timber species in California, and as we plant young blister rust-susceptible seedlings in our reforestation program we are bound to put some in areas where they will be exposed to infection by this rust. We cannot prevent these sugar pines from becoming infected; but if we are aware early enough that infection has occurred, we do have the option of preventing most of the tree mortality by pruning out infected branches. Such a pruning strategy may not be practical to use in a plantation subjected to continual, year after year, infection pressures. But it could be effective in those plantations, such as the N. Shirttail Plantation, where a blister rust infection wave occurred in just one year and all or almost all infections had their origin in that year. In this case, an early pruning of branch infections before the cankers reached the bole would have been effective in preventing tree mortality; and, since only one period of infection has occurred, only one pruning effort would have been needed in the first 10+ years of the plantation. In order to be effective, this type of pruning should be done shortly after (1 to 2 years) the branch cankers become visible. This would require an annual inspection of sugar pine plantations for their first 15 years. After that, because infections tend to occur out in the needled portions of the lower crown, fewer lethal cankers develop as a result of infection. Those cankers which are lethal are slow enough in developing that the tree has a good chance of reaching commercial size before being killed by the rust.

Lastly, in the area of blister rust prevention, it is highly recommended that the Forest and/or District maintain accurate, accessible records of the site and/or stands where blister rust has occurred and its effects on the sugar pine component of the stand. Such records are invaluable in determining if sugar pine should be planted in an area. With such information available, we can avoid putting sugar pine in areas prone to rust infection.